

Geographic Information Systems

Mapping Resources for Watershed Management



The image at left is an orthophotograph (an aerial picture transformed so that it can be used as a map) of the Wachusett Reservoir's Thomas Basin. The topographic map on the right shows the same area; it not only provides directions, but also presents natural, scientific and cultural expressions of the landscape.

Map by DCR/DWSP and MassGIS

A good map tells a story about a place. Modern cartographers use computerized Geographic Information Systems (GIS) to process a wide range of data in order to convey tales about our world. DCR's Office of Watershed Management (OWM) has been utilizing this technology for over twenty years to help maintain the purity of the drinking water in the Quabbin and Wachusett Reservoirs. The following are some of the many ways that OWM uses GIS in its daily operations.

What is GIS

"GIS is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information." (excerpt from www.gis.com, an excellent source of introductory GIS material).

GIS is distinct from other computerized drawing programs in its ability to integrate data with geospatial references in order to analyze and model information. The mapping element can be

GIS MAPPING - SEE PAGE 3



- SPECIAL INSERT -

Quabbin Public Access Plan Summary

In This Issue:

As the Autumn leaves fall, the air is crisp, the insect population thins, and DCR field staff find it easier to make their way into the woods to check on forest health. The feature story in this issue of *Downstream* focuses on a mapping resource that has become a valuable tool for watershed management. Read on and see how Geographic Information Systems serve as a guide to land preservation and maintenance of high water quality standards.

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Department of Conservation
and Recreation
Division of Water Supply
Protection
www.mass.gov/dcr/waterSupply.htm

The Legend of Mine Swamp Brook

A spooky tale for a dark and stormy night...



In the days before the construction of the Wachusett Reservoir (completed in 1906), the banks along the Nashua River from the northern end of Boylston to the Clinton town line had become a place known for stories of bad luck, and superstition. The following legend may help explain why people felt this way about an otherwise quiet country valley.

Thomas Cunningham was a Scotsman who was involved in local commerce and industry around the time of the Civil War. Most notably, he constructed a picnic grove on land along the Nashua River. The grounds became famous for summer clam bakes where visitors could arrive by a steamboat which travelled the river. The hillside that served as a backdrop for the grounds is now an island known as Cunningham's Ledge. Adjacent to the ledge Mr. Cunningham ran a mill that was powered by "Mine Swamp Brook" which fed into the Nashua River. At the time, the ravine in which Mine Swamp Brook could be found was remote and there were few houses in the area.

Those who were superstitious believed that this place was haunted due to numerous unfortunate events that took place. One significant such event is the

story of two young girls named Mary and Charlotte Sawyer, who were visiting friends in Boylston and were riding together on the same horse. The story goes that their trusted old horse was trying to cross the swollen Mine Swamp Brook during a heavy rain storm when it slipped on the mossy rocks and fell into the rushing waters. Both girls were lost in the torrent and drowned. After that time, some claimed that on quiet nights they could still hear the galloping of the old horse, possibly in search of its young riders.

Not long after the sad fate of the Sawyer girls, an unknown man was found lying on a roadside in the Burdett Hill area of Clinton. The man, suffering from smallpox, was taken to a nearby house where he soon died. He was never well enough to give his name and was anonymously buried nearby.

As construction of the Wachusett Reservoir commenced in the 1890s, the unfortunate incidents continued. In this particular area of reservoir construction, there were of number murders and assaults among the workers. Several accidents were documented involving horse and cart, with workers being

trampled. There was also one event where it was unclear why a horse became so frightened that it and its cart veered off the trail into a wall.

Also attributed to the area's bad luck were over 100 cases of malaria contracted along the banks of the Nashua River during construction. There was also an incident in the winter of 1895 when one of the laborers for the Wachusett Reservoir had a narrow escape from drowning. The worker had crossed the river in a small boat to a tool house to pick up some equipment. While inside the tool house, his boat slipped its line and began to float away. In an effort to retrieve it, the worker stepped out onto a patch of ice hoping to reach the boat, but the ice gave way and he fell into the water. Another laborer who saw the event, got another boat and rescued him. The man in the icy water had been clinging onto a chunk of ice and was too cold to swim any longer when he was finally pulled to safety.

Today the small valley known for bad luck rests deep under the surface of the Wachusett Reservoir. Some still say that when conditions are just right, one can hear the galloping of a horse, maybe in search of its riders.

GIS MAPPING - FROM PAGE 1

conceptualized as layers of information, manipulated to create a visual perception of an area. The associated data can then answer questions about the place (see box below). GIS is a powerful tool that is used by millions of people worldwide in all sectors of business and government.

Land Acquisition

The Office of Watershed Management has spent \$118 million since 1985 to acquire 20,000 acres of land. These purchases were not random; GIS modeling of key land characteristics, such as hydrography, topography, and ownership, helped focus the agency's acquisitions. According to Jim French, OWM Land Acquisition Coordinator, "GIS has been key to our success in protecting critical parcels for water quality." The Watershed Land Sensitivity Index is an analysis developed by the OWM GIS staff that depicts how important a piece of property is in regards to its water yield and pollution buffering capacity. While DCR has increased its percentage of land in the Wachusett Reservoir watershed from 8% to 26%, the Watershed Land Sensitivity Index of critical lands has jumped to 37% of the

most critical lands in the Wachusett Reservoir watershed. This GIS guided strategy has allowed OWM to maximize each dollar it spends on land.

Watershed Protection Act

Another element to OWM's success in maintaining water quality has been the Watershed Protection Act (WsPA). This set of laws regulates land use in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds, primarily within 400 feet of the reservoirs and their tributaries. The use of GIS in the mid-1990s to identify regulated areas for the implementation of the WsPA was a pioneering example of this technology's power. GIS continues to be a crucial tool for the enforcement of these regulations. Nancy McGrath, Regional Planner in the OWM Wachusett Section, notes that, "the GIS mapping of tributaries, regulatory buffers, property boundaries, and ownership information is the cornerstone to communication with the public that is effected by WsPA." An program showing Watershed Protection Act buffers is available on-line at http://maps.massgis.state.ma.us/mdc_wsapa/pages/main.jsp; more detailed information on the Act is

also available on the web at www.mass.gov/dcr/waterSupply/watershed/wsapa.htm.

Natural Resource Management

DCR owns over 100,000 acres of land in the Quabbin Reservoir/Wachusett Reservoir watershed system. Managing the natural resources over this vast area is an important aspect to water quality maintenance. OWM Foresters utilize GIS to identify, map, and track timber cutting contracts, as well as monitoring the health of the watersheds' forest and maintaining boundaries. Dan Clark, OWM's Wildlife Biologist, uses GIS to track a variety of species. "GIS helps me monitor population, impacts on water quality, and OWM's subsequent land and wildlife management decisions for beavers, deer, moose, aquatic mammals, and vernal pools."

Environmental Quality

The Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds encompass over 250,000 acres of water and land. This 400 square mile watershed

GIS MAPPING - CONTINUED ON PAGE 6

What's in a GIS map?

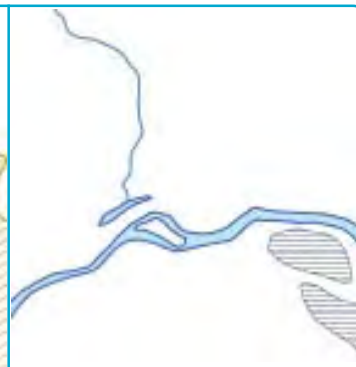
GIS can create a complex map comprised of several layers of data. For example, the first five images to the right show a variety of information about one place, as described in its title. When the layers are combined together, as seen in the last map on the lower right, sophisticated analyses can be performed, both visually and with further computer assistance.



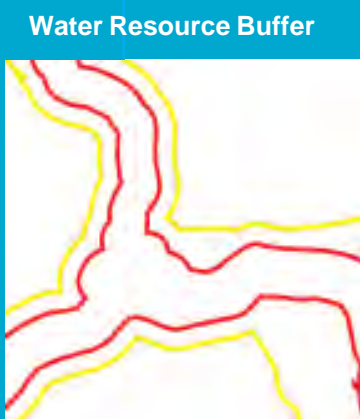
Parcels



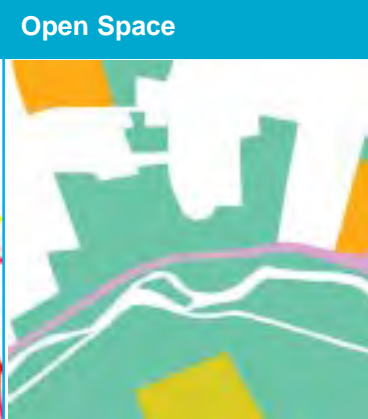
Wildlife Habitat



Hydrography



Water Resource Buffer



Open Space



Quabbin Reservoir Bathymetry Project

The Swift River Valley's terrain elevation was surveyed in the late 1920s prior to the area transforming into the Quabbin Reservoir. This elevation data, displayed as contour lines of the terrain, is referred to as *hypsoetry* over land and *bathymetry* under water. Thus the hypsoetry of the Swift River Valley became the Quabbin Reservoir's bathymetry.

The survey data consisted of 140,480 elevation points, mapped out on 81 individual canvas map sheets overlapping the area that was to become the reservoir. These maps, however, are not conducive for modern use, whether for a relatively simple review of reservoir depths and contours or more complex geographic analyses. To garner the power of current computerized Geographic Information Systems, it was necessary to develop a digital Reservoir Elevation Geodatabase.

Conversion Process

Developing the Reservoir Elevation Geodatabase was a three step process:

1. Determine the Geographic Coordinate System and Datum.

The Quabbin Reservoir elevation data was mapped in the 1920s using a specially designed Quabbin Coordinate System in the Clarke 1866 Datum (NAD27). All the map coordinates needed to be converted from this Quabbin System to Massachusetts State Plane Coordinate System in North American Datum 1983 (NAD83). The rectification process used the ESRI ArcInfo "Transform" command to apply a mathematical equation to adjust the projection of all the coordinates. This polynomial calculation requires a minimum of three registration points with both Quabbin System and MA State Plane coordinates. Fortunately three Mass Highway Triangulation Stations were identified – Quabbin Hill, Shere, and

Whitney Hill – that existed in the 1920s, are currently maintained, and have corresponding Quabbin coordinates.

2. Define Attributes.

A database, referred to as the attribute table, had to be defined and formatted for the geodatabase. The attributes are the information associated with each segment of geographically identified spaces. For this project, the attributes are the elevation information for each line.

3. Convert Elevation Data.

Finally, the elevation data on the canvas maps required conversion into a digital format. Individual maps were placed on a special tablet and elevation points digitized into a single geodatabase. These points were then projected into the current state plane coordinate system using the conversion process described in the first step.

Upon completion of the Reservoir Elevation Geodatabase, a surface model was generated using ArcInfo TIN (Triangulation Irregular Network) Module based on the MassGIS photogrammetric delineated Reservoir boundary. Bathymetric contour lines were interpolated from the Reservoir surface model (see map; for those with GIS capabilities, this coverage is currently available on-line at the MassGIS website, <http://www.mass.gov/mgis/qrbath.htm>).

Using Bathymetry

The benefits of this geodatabase, beyond generating bathymetric contours and a surface model for impressive map displays, is to provide safer boat navigation on the Reservoir, conduct volumetric analysis by depth and region, and to support future watershed management Reservoir studies.

One of the first studies completed using this new bathymetric information was a volume analysis of the Quabbin Reservoir. The Reservoir volume calculated from the surface module was 419 billion gallons at

Projections and Coordinate Systems

Mapping is often an effort to present a section of our three-dimensional, curved planet onto a two-dimensional, flat piece of paper (or computer screen). "Imagine taking a basketball, cutting it in half, and then attempting to flatten it," is how Paul Penner, GIS Coordinator for the Division of Water Supply Protection, explains the cartographer's dilemma. "There will always be a distortion of geographic reality. However, the smaller the area being mapped, the less distortion that occurs from flattening the view into two dimensions."

Cartographers and surveyors utilize coordinate systems to locate points on the earth's surface. If the area being mapped is small enough, a grid can represent the round world on a flat surface with very little distortion. Luckily Massachusetts is considered a small enough area to fit into its own State Plane Coordinate (SPC) System. MassGIS stores all of its spatial data in MA SPC using the 1983 North American Datum (NAD83) reference system.

The National Geodetic Survey (www.ngs.noaa.gov) is responsible for accurately measuring the shape of the earth and technical coordination of the NAD reference system. Just as satellites, GPS, and computers have taken the place of transits and hand calculations, these coordinate systems have also been upgraded over time. Data originating in another reference system must be converted into NAD83 before it will align with current data.

Map projection is a very complex, fascinating topic that can not be accurately described in a few paragraphs. More thorough primers on this subject can be found on the web. [The National Atlas, nationalatlas.gov/articles/mapping/a_projections.html](http://TheNationalAtlas.nationalatlas.gov/articles/mapping/a_projections.html), is a production of several federal agencies; the National Geographic Society's explanation of projections is [Round Earth/Flat Maps](http://RoundEarth/FlatMaps), www.nationalgeographic.com/features/2000/exploration/projections.



Department of Conservation and Recreation
Division of Water Supply Protection
Office of Watershed Management

Quabbin Reservoir Watershed System 2006 Public Access Management Plan Update

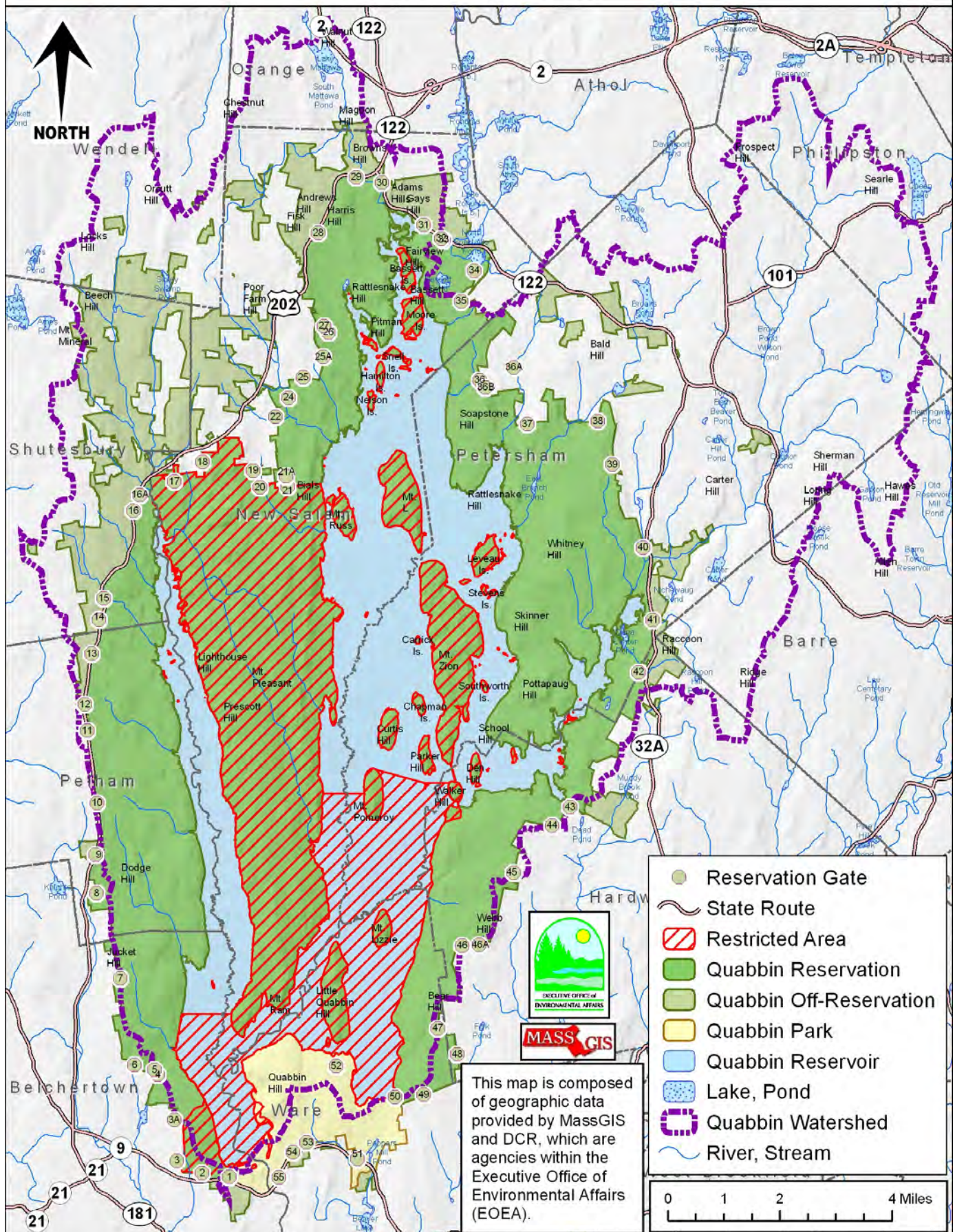
The Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management (DCR/DWSP/OWM) is responsible for the active and reserve water supply sources contained within the Quabbin Reservoir, Ware River, Wachusett Reservoir and Sudbury Reservoir watersheds. DCR/DWSP/OWM and its predecessors have a long tenure of providing high quality drinking water to the citizens of Massachusetts. There are a variety of federal and state laws that OWM must work under as a drinking water manager. OWM is also responsible for implementing its own regulations in its efforts to protect the source drinking water for approximately one third of the Commonwealth.

The Quabbin Reservoir is the primary drinking water supply in this watershed system. DCR/DWSP/OWM owns over 82,000 acres of land and water in the Quabbin Reservoir watershed. While DCR manages this watershed primarily for water quality protection, drinking water supply, and environmental resource protection purposes, these vast areas are also used by the public for recreation.

The first Public Access Plan for the Quabbin Reservoir watershed was published in 1988. This plan outlined control policies and monitoring mechanisms used to mitigate possible negative impacts from public access to Watershed Management property in Barre, Belchertown, Hardwick, New Salem, Orange, Pelham, Petersham, Shutesbury, Ware, and Wendell. An update was completed ten years later in 1998. This most recent update was initiated in 2005, completed in spring 2006, and officially adopted in July 2006.

DCR and its predecessor have continuously involved stakeholders in its public access policy development, review, and modification. The planning process for this latest update included two public meetings, a visitor survey, an abutter's survey, and a public hearing. DCR continuously receives pressure to allow new recreational opportunities and increase the availability of currently allowed activities. The input received while updating the Quabbin Access Management Plan demonstrated, however, that local residents, land abutters, visitors, and environmental organizations are supportive of DCR's policies to protect the public water supply while allowing controlled access to these resources.

The following map and table provide a summary of the policies described in the 2006 *Public Access Management Plan Update: Quabbin Reservoir Watershed System*. The complete document, which integrates current regulations and legislation into updated policies, is available on-line at www.mass.gov/dcr/waterSupply/watershed/dwmpplans.htm and click on Quabbin Reservoir Watershed Public Access Plan Update. Copies are also available at the Quabbin Visitors Center or town libraries in the watershed. The public access policies for the entire DCR water supply watershed system are available on-line at www.mass.gov/dcr/waterSupply/watershed/pacc.htm. For further information, please contact the Quabbin Visitor's Center at (413) 323-7221.





Quabbin Reservoir Watershed System

2006 Public Access Summary

Activity	Quabbin Park	Quabbin Reservation	Off-Reservation	Quabbin Reservoir	Regulating Ponds ^a	Off-Watershed Ponds ^b
VEHICLE ACCESS						
Driving for Sightseeing	<input type="checkbox"/> 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Snowmobiling	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ATV Riding	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Bicycling -Designated Roads	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Off-road Bicycling	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sledding	<input type="checkbox"/> 6	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
FOOT ACCESS						
Walking/Hiking/Snowshoeing	<input type="checkbox"/> 7	<input type="checkbox"/> 7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cross-country Skiing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Hunting/Trapping	<input checked="" type="checkbox"/> 8	<input checked="" type="checkbox"/> 8	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Ice Fishing/Ice Skating	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> 9
Shore Fishing	<input checked="" type="checkbox"/> 10	<input type="checkbox"/> 11	<input type="checkbox"/> 12	<input type="checkbox"/> 11	<input type="checkbox"/> 11	<input type="checkbox"/> 12
WATER ACCESS						
Boat Fishing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> 13	<input type="checkbox"/> 14	<input type="checkbox"/> 14	<input type="checkbox"/> 13
Canoeing/Kayaking/Boating	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> 14	<input type="checkbox"/> 15
Wading (fishing, launching)	<input checked="" type="checkbox"/> 16	<input type="checkbox"/> 17	<input type="checkbox"/> 17	<input checked="" type="checkbox"/> 18	<input type="checkbox"/> 18	<input type="checkbox"/> 16
Swimming	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OTHER ACCESS						
Group Activities (e.g., weddings)	<input type="checkbox"/> 19	<input type="checkbox"/> 19	<input type="checkbox"/> 19	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Geocaching/Questing	<input type="checkbox"/> 20	<input type="checkbox"/> 20	<input type="checkbox"/> 20	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Wildlife/Bird Watching	<input type="checkbox"/> 7	<input type="checkbox"/> 7	<input type="checkbox"/> 7	<input type="checkbox"/> 7	<input type="checkbox"/> 7	<input type="checkbox"/> 7
Night Access	<input checked="" type="checkbox"/> 21	<input type="checkbox"/> 22	<input type="checkbox"/> 22	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> 21
Organized Sports	<input checked="" type="checkbox"/> 24	<input checked="" type="checkbox"/> 24	<input checked="" type="checkbox"/> 24	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Dogs/ Other Animals	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Horseback Riding	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Collecting/Metal Detecting	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Camping	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fishing Derbies	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Target Shooting	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Advertising	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Marking – Trail/Roads (unauthorized)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Alcohol (possession of)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Other	Please call the Quabbin Visitor Center 413-323-7221 or Watershed Ranger Station 413-323-0192					

LEGEND: Prohibited – ☒

Allowed - general restrictions – ☐

Specific Conditions – ☐ #

^a The areas on the reservoir above the horseshoe dams at Gates 31 and 43

^b South Spectacle Pond, Bassett Pond, and Peppers Mill Pond

General Restrictions:

General public access within the Quabbin Reservoir Watershed System is restricted to one hour before sunrise and one hour after sunset through gates or designated (posted) areas only. Any activity which injures or defaces the property of the Commonwealth is strictly prohibited. This chart is based on the Watershed Protection Regulations 350 CMR 11.00, copies of which are available at the Quabbin Visitor Center. Littering is strictly prohibited. Carry in/Carry out. Don't feed wildlife.

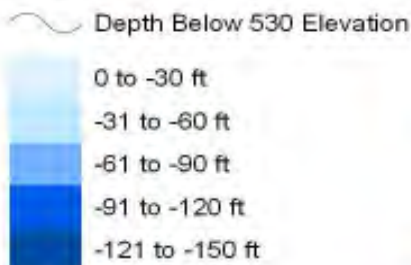
Specific Restrictions:

- ¹ The Winsor Dam and Goodnough Dike have restricted vehicle access for security reasons.
- ² Snowmobiling is allowed only on the DCR designated trail located on Off-Reservation land. 304 CMR 12.29 applies.
- ³ Bicycling is only allowed on designated roads in Quabbin Park. See DCR Bicycling maps. Helmets and protective gear are required by MA law for children under 16 years of age and recommended for others
- ⁴ Bicycling is allowed only on designated roads through DCR gates 29, 30, 31, 35, 40, 43A & B, and 44. Bicycling is only allowed on designated roads through Gate 8 during fishing season. See DCR Bicycling map for designated roads.
- ⁵ Bicycling is allowed on main forest roads only within Off-Reservation lands with seasonal restrictions (e.g., mud season).
- ⁶ Sledding or any other kind of sliding activity is prohibited on the reservoir, the dams and other structures.
- ⁷ Walking, hiking, or snowshoeing access is allowed within the Quabbin Reservoir Watershed system, except in restricted areas (e.g., Prescott Peninsula, posted Administration Areas, Reservoir islands and along the baffle dams-November 15 – June 15).
- ⁸ Hunting and Trapping are prohibited except by special permit during the Quabbin Controlled Deer Hunt and associated Paraplegic Hunt. Contact the Quabbin Visitor Center for more information.
- ⁹ Ice fishing, ice skating, and carry-in boat access allowed on three Off-watershed ponds: South Spectacle, Bassett and Peppers Mill Ponds only. Please call Watershed Rangers, if accessing, as a courtesy at 413-323-0192.
- ¹⁰ No fishing in Quabbin Park except catch-and-release fly fishing (allowed all year) below the Winsor Dam in the Swift River, unless posted.
- ¹¹ Shore fishing along the Reservoir and along streams is permitted between Gates 8-West Branch Swift River, and 22-44 (except on baffle dams), by foot, during the designated Quabbin Fishing Season only. See the current Quabbin Fishing Guide and Map available at the Quabbin Visitor Center.
- ¹² Shore fishing within off-reservation lands and along off-watershed ponds is allowed year round according to State Fishing regulations.
- ¹³ Carry-in boat access is allowed on off-watershed ponds. See Night Access Policy, if applicable.
- ¹⁴ Boat access on designated areas of reservoir or regulating ponds requires valid MA Fishing License and size/motor restrictions. Wearing boots is mandatory if wading while launching or removing boats at designated areas from the Reservoir. Fishing access using canoes, kayaks, or jon boats is allowed only through Gate 31 above regulating dam and through Gate 43 on Pottapaug Pond with restrictions. Contact the Quabbin Visitor Center at 413-323-7221 for more information regarding current Fishing Guide.
- ¹⁵ Allowed subject to MA Boating regulations. Please call Watershed Rangers, if accessing, as a courtesy at 413-323-0192
- ¹⁶ Wading is allowed Off-watershed below the Winsor Dam Power Station on the Swift River
- ¹⁷ Wading with boots is allowed between Gate 8-West Branch Swift River, and Gate 22-44, except in restricted areas, and in Off-Reservation tributaries.
- ¹⁸ Wading is prohibited except while launching or removing boats while wearing boots, at designated boat launch areas.
- ¹⁹ Allowed without a permit for groups of less than 25 individuals and/or less than 10 cars and/or 10 motorcycles. Permit required for group of 25 through 100 individuals and/or 10-40 cars/motorcycles or 1 bus. Permit and Ranger required for larger groups or other combinations.
- ²⁰ Special permit from Visitor Center required for any cache placement.
- ²¹ Night access within Quabbin Park is prohibited with two exceptions. It is allowed without a permit on Swift River below Y pool, if access is from Route 9, and on Peppers Mill Pond.
- ²² Night access within Quabbin Reservation is allowed by permit for pedestrians only through Gates 16, 31, 35, 41, and 43 only during the designated Quabbin Fishing season. Night access directly from 122 is allowed without a permit on South Spectacle Pond (off-watershed). Night access is allowed on Off-Reservation lands with special permit. Contact Quabbin Visitor Center for permit information.
- ²³ South Spectacle, Bassett, and Peppers Mill Ponds.
- ²⁴ Prohibited except with written permission from the Commissioner.

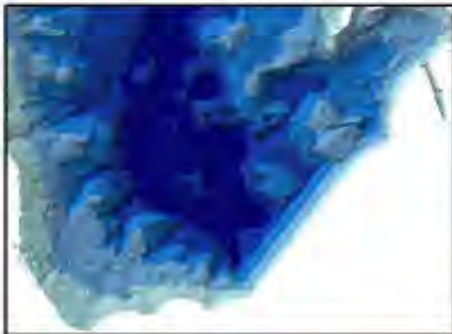
Quabbin Reservoir Bathymetry



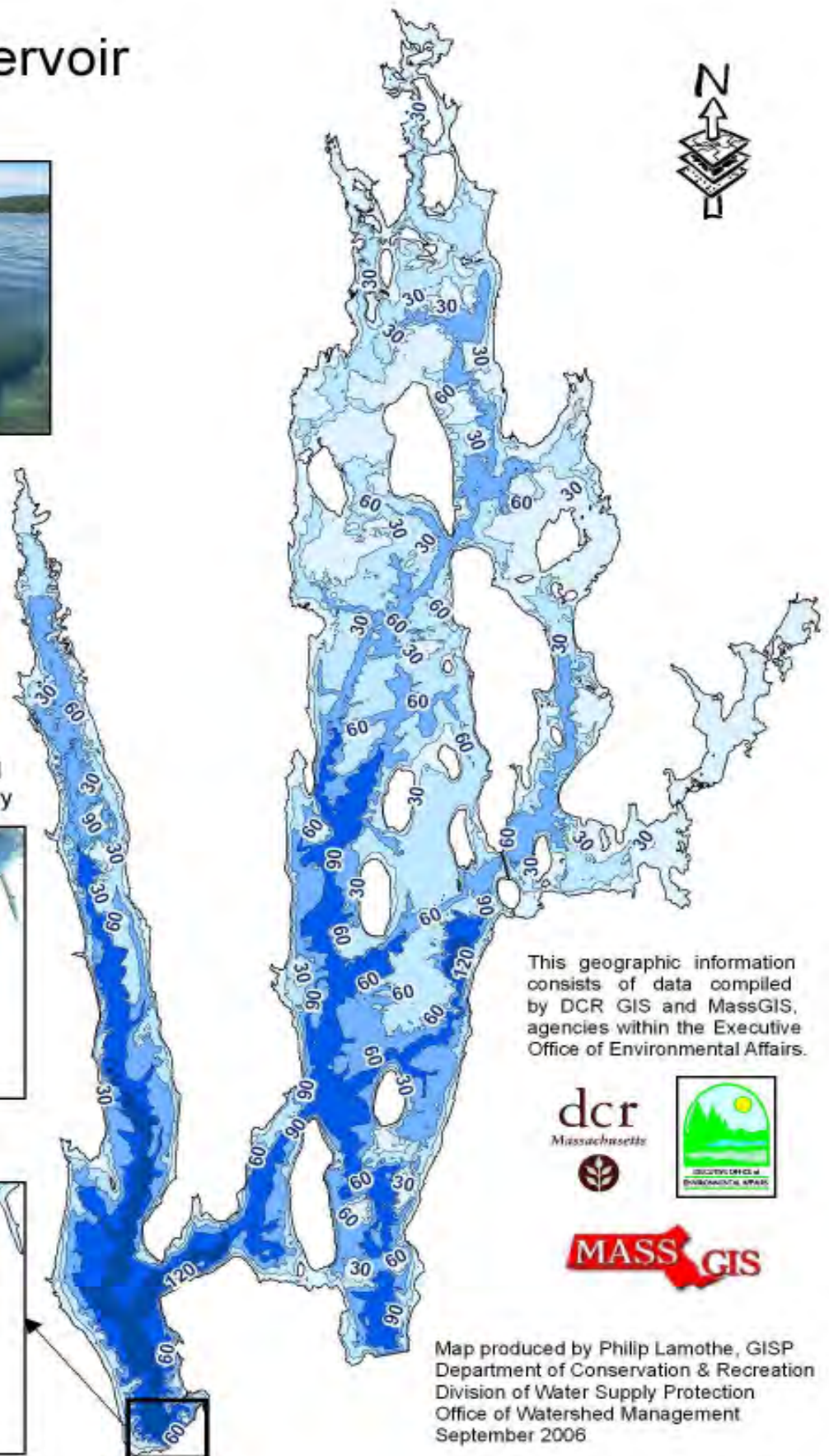
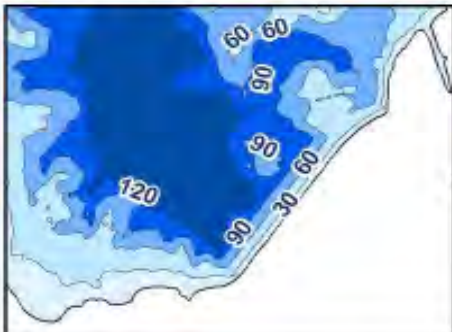
Legend



Quabbin Reservoir
Elevation Surface (TIN) Model
used for generating bathymetry



Quabbin Reservoir
Bathymetry at Winsor Dam



This geographic information
consists of data compiled
by DCR GIS and MassGIS,
agencies within the Executive
Office of Environmental Affairs.



Map produced by Philip Lamothe, GISP
Department of Conservation & Recreation
Division of Water Supply Protection
Office of Watershed Management
September 2006



The Massachusetts Geographic Information System

MassGIS is the Commonwealth's Office of Geographic and Environmental Information, housed within the Massachusetts Executive Office of Environmental Affairs. Through MassGIS, the Commonwealth has created a comprehensive, statewide database of spatial information for environmental planning and management. The state legislature has established MassGIS as the official state agency assigned to the collection, storage and dissemination of geographic data.

The MassGIS website, mass.gov/mgis/massgis.htm, is a treasure trove of information for novice or advanced practitioner. An on-line mapping program, www.mass.gov/mgis/mapping.htm, offers anyone a chance to view much of this data.



GIS MAPPING - FROM PAGE 3

system is comprised of many sub-watersheds, each with their own unique characteristics of topography, hydrography, and land use. OWM Environmental Quality staff utilize GIS to help monitor a wide variety of impacts to water quality, track water quality trends, and locate sources of pollution. According to Pat Austin, EQ Director for the Wachusett Section, "GIS modeling of impacts from stormwater and other non-point pollution allow us to identify problem areas before they impact the source water supply for over 2 million people."

Education

The maps and data analyses created with GIS not only help OWM in its daily tasks, but they also provide helpful information to the public. Jim Lafley, OWM Wachusett Section Education Program Coordinator, relies on watershed maps to teach students about their location in the watershed and their relationship to the metropolitan Boston drinking water supply. "Both children and adults gain a tremendous amount of knowledge of the environment by studying the maps produced by OWM's GIS staff." A bathymetry map of the Wachusett Reservoir, showing the depths within the reservoir itself, is currently featured at the Stillwater Farm Education Center in Sterling. The public also benefit from the many maps produced showing areas of

public access on watershed management lands (www.mass.gov/dcr/waterSupply/watershed/maphome.htm).

Professional Support

The Office of Watershed Management is fortunate to have dedicated GIS professionals on its staff to support the many uses described above. Paul Penner, Director of the OWM GIS program, has seen the growth of this technology. "Planners, Engineers, Foresters, Educators, Administrators...every aspect of Watershed Management benefits from GIS. OWM, with the support of MassGIS, utilizes this combination of computerized mapping and data every day in our quest to provide superior drinking water while managing the natural resources entrusted to our care for future generations."

- Joel Zimmerman - DCR Regional Planner



BATHYMETRY - FROM PAGE 4

the official 530 foot elevation. This is 1.7% higher than the official Reservoir Yield Data calculation of 412 billion gallons.

Another recent example of a project utilizing the Quabbin bathymetry is the geographic analysis of shallow areas, referred to as the Littoral Zones, favorable to invasive aquatic plants. The Massachusetts Water Resource Authority (MWRA) requested Littoral Zone maps, with acreage figures, for a contract bidding process to help evaluate invasive species. The chosen contractor received the Littoral Zone geodata for their GPS units in order to safely navigate and stay within the perimeter of these zones during their field work.

The Quabbin Reservoir bathymetry information will facilitate scientific studies on reservoir dynamics and water quality. Ongoing technological improvements in computer hardware and software will continue to help develop a vast and powerful array of geospatial analytical tools for future research and management.

- Philip Lamothe - DCR GIS/GPS Specialist.
Thanks to: Bob Bishop, Peter Izyk, Paul Penner, and Paul Reyes (DCR); Don Sluter (UMass GeoScience Dept.); and Michael Trust (MassGIS).

A Matter of Scale

Bob Bishop, Director of the Environmental Quality Section at Quabbin Reservoir, stands in front of a map of the Quabbin Reservoir and Ware River watersheds. This wall sized map is a 1:12,000 scale version of the 283 sq. mile area (that means that 1 inch represents 12,000 inches). Maps of all scales, from parcel specific to the entire region, on paper and on screen, support Office of Watershed Management staff – Environmental and Civil Engineers, Planners, Foresters, Land Acquisition, Biologists and Rangers – in their efforts to maintain the source of high quality drinking water for the metropolitan Boston region.

Photo by DCR/DWSP

For More Information about GIS and mapping...

Check out these books

The Mapmakers, John Noble Wilford. (2001) Knopf Publishing Group

How To Lie With Maps, Mark Monmonier. (2002) University of Chicago Press.

Beyond Maps: GIS and Decision Making in Local Government, John A. O'Looney. (2000) ESRI Incorporated.

...or these websites

www.local.live.com

A Microsoft powered site with maps, aerial photography, and "bird's eye" views where available.

www.earth.google.com

Google Earth, "A 3D interface to the planet."

www.mywonderfulworld.org

A National Geographic-led effort to expand geographic learning in school, at home, and in the community.

And Another Thing...

by J. Taylor



Kids' Corner

Where in the Watershed Are You?

A watershed is all the land around a body of water that sends water down to help fill that water body. A watershed can be very small, like the area around a puddle in a parking lot. They can be very large, like the Mississippi River watershed, encompassing over half the United States.

You can identify the connection between your home or school and your watershed by using a series of maps, including ones of your town, of the regional area and the state, that contain symbols for brooks, streams, rivers, lakes and ponds.

Materials you will need: Several maps that include your community at different scales, or levels of information. The *Arrow Street Atlas* series is a good source of town maps with streets and bodies of water. The *Massachusetts Atlas* is an excellent map using a larger scale that shows a more regional view. Road maps of Massachusetts or southern New England provide a picture of a very big area. Maps can be found in your local library or purchased.

Procedure: To start, find the location of your house or school using the town map. Water from your yard flows downhill toward a body of water, for example a brook, pond, swamp or river. Next, determine the direction in which the water is flowing. Look for a thin blue line, which represents a river. If you follow the line in one direction and it ends abruptly, that indicates you reached the beginning, or headwaters, of the stream. If it flows into a lake or pond or another stream, then you are going in the right direction! If you are at a pond, find the outlet – the place where another stream attaches to the pond – and keep following it until you reach an intersection with a larger body of water.

Keep following the blue lines, and soon you will reach the edge of the town map. Now switch to a map that has several towns, like the *Massachusetts Atlas*. Find a location close to where you stopped on the previous map. Continue to follow the water downstream.

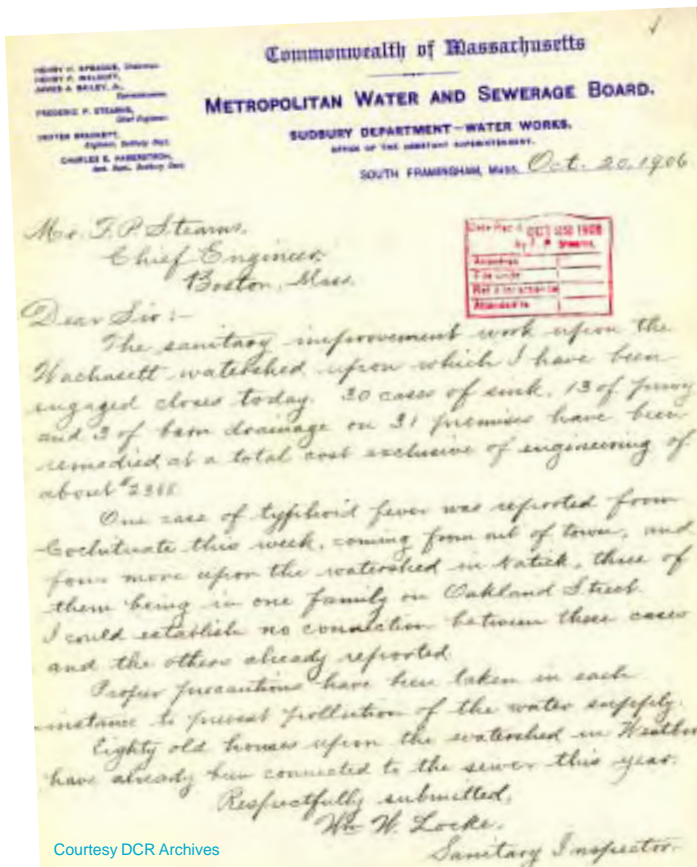
When you reach the edge of the regional map, it is time to switch again, this time to the road map of the state or southern New England. Find the place on that map that corresponds to where you left the regional map. Often you can find a town, park or river intersection on this large map.

Your trip through the watershed will eventually lead to an ocean, a bay or a sound. All of the watersheds in Massachusetts are part of the Atlantic Ocean Watershed. If you are able to lay the maps next to each other you will be able to see the water's journey from your home or school to the salt water.

Discussion Questions: Can you tell from the map what watershed you live in? Are there any watersheds upstream of your house or school? Have you ever visited or driven by other watersheds?

Further Study: The Environmental Protection Agency's "Surf Your Watershed" website, www.epa.gov/surf, is an easy-to-use program to help identify your watershed.

- Jim Lafley - DCR/DWSP Education Coordinator



A Sanitary Survey report written 100 years ago.

Sanitary Surveys - 100 Years Ago

The Boston Water Board (BWB) began employing inspectors in the late 1880s to investigate sources of pollution within the water supply watersheds. When the Metropolitan Water Board (MWB) took control of the Sudbury, Cochituate and Mystic Watersheds from the BWB in 1898, the MWB continued the practice, and expanded it to include the Wachusett Watershed. In February 1898, the MWB hired a MIT educated sanitary engineer, William W. Locke, to manage the sanitary inspection office, a position he held until his retirement in 1935.

The archival records of the Metropolitan Water Works (MWW - the name given to the system by the MWB) includes Mr. Locke's handwritten weekly report letters to the Chief Engineer, 1900-1913.

The sanitary inspector investigated all water contamination sources in the watersheds, including residential cesspools and privies, waste from animal pens, and wastes from manufacturing mills. He also recorded new house lots and sewer connections, investigated cases of waterborne illnesses (including typhoid fever and dysentery), enforced the sanitary rules and regulations of the MWW, and oversaw filter beds to purify sewerage within watershed drainage areas. These handwritten reports are very rich in detail and are precursors to the Environmental Quality Assessments currently performed by the Office of Watershed Management. For more information on water quality reporting, go to www.mass.gov/dcr/waterSupply/watershed/dwmwq.htm.

- Sean Fisher - DCR Archivist

DOWNSTREAM

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Downstream is produced twice a year by the Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection. It includes articles of interest to residents of the watershed system communities. Our goal is to inform the public about watershed protection issues and activities, provide a conduit for public input, and promote environmentally responsible land management practices.

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